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CLINICAL RESEARCH

Videoconference pediatric and congenital cardiology consultations: a new application in telemedicine

Consultations de cardiologie pédiatrique et congénitale
par vidéoconférence : une nouvelle application de la télémédecine

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KEYWORDS

Telemedicine;
Videoconference;
Pediatric
and congenital
cardiology;
Echocardiography.

Summary

Background. – The relative rarity of congenital heart disease gives it an orphan disease status, requiring specialised centres. The present maturity of information technology allows telemedicine to be integrated into current medical practice. We report our experience of telemedicine between the cardiology department at St Pierre Hospital on the island of Réunion and the pediatric cardiology department at the teaching hospital in Toulouse.

Aims. – The aims of this work were to [1] verify the technical feasibility of transmitting echocardiographic images, [2] determine an optimal therapeutic strategy for each patient, and [3] deliver precise information live to patients and their families.

Methods. – Five pediatric cardiology videoconference consultation sessions were transmitted between April 2006 and May 2007. The videoconference equipment, POLYCOM VSX 7000 (R), was used to relay information between the two centres, using six high-debit digital telephone lines, allowing a transfer rate of 384 kbits/s and an image frequency of 25 frames per second. The echocardiographic equipment at St Pierre Hospital was connected to the videoconference equipment by an S-VHS video output. The transmitted sources alternated between the echographic video output and the signal from a video camera, with continuous audio transmission.

Results. – The telemedicine meeting was made up of three main elements: [1] a consultation with real-time echocardiographic acquisition and transmission, [2] a discussion between medical colleagues, and [3] a discussion with the family. Five videoconference consultation sessions were organised between April 2006 and May 2007. 22 patients were involved (median age 3 years, age range 7 days to 48 years). Heart disease was congenital in 20 patients, and acquired in 2 patients. The aim of the telemedicine consultation was to specify: [1] medical treatment in 7 patients, and [2] an indication for surgery or interventional catheterisation in 15 patients. There was no significant change in diagnosis, but in 2 patients with complex heart disease some anatomical clarifications were made. For 3 patients, the videoconference discussion was essential to get the extremely reticent families to accept the indication for surgery.

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MOTS CLÉS

Télémédecine ;
Vidéoconférence ;
Cardiologie
pédiatrique
et congénitale ;
Échocardiographie.

Conclusion. – This is the first experience in France of telemedicine consultation for pediatric and congenital cardiology. These videoconferences allowed patients in the south of Réunion to benefit from a specialist opinion on optimal therapeutic strategy, with no delay or need to travel a long distance.

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Résumé

Justification. – La relative rareté des cardiopathies congénitales leur confère un statut de maladies orphelines justifiant de faire appel à des centres spécialisés. La maturité actuelle de la télématique permet de façon courante d'intégrer la télémédecine à la pratique médicale. Nous rapportons notre expérience de télémédecine entre le service de cardiologie du CH de St-Pierre de la Réunion et le service de cardiologie pédiatrique du CHU de Toulouse.

Objectifs. – Le but de ce travail était 1) de vérifier la faisabilité technique de transmission des images échographiques, 2) de déterminer pour chaque patient une stratégie thérapeutique optimale, 3) de délivrer en direct aux patients et leur famille une information précise.

Methodes. – Cinq consultations vidéotransmises de cardiologie pédiatrique et congénitale ont été réalisées entre mars 2006 et mai 2007. L'équipement de vidéoconférence, POLYCOM VSX 7000 (R), relie les 2 centres par six lignes Numéris offrant un débit de 384 kbits/s et une cadence image de 25 images par seconde. L'échocardiographe du CH de St-Pierre était raccordé au matériel de vidéoconférence par la sortie vidéo S-VHS. Les sources transmises étaient en alternance la sortie vidéo de l'appareil d'échographie, et le signal d'une camera vidéo, avec transmission audio continue.

Resultats. – La réunion en télémédecine se composait en 3 parties : 1) consultation avec réalisation et transmission en temps réel de l'échocardiographie, 2) discussion collégiale médicale et 3) entretien avec la famille. Cinq séances de consultations par vidéoconférence ont été organisées entre avril 2006 et mai 2007. Vingt-deux patients (âge médian 3 ans, âges extrêmes 15 jours-48 ans) ont été examinés. Les cardiopathies étaient congénitales chez 20 patients et acquises chez 2 patients. Le but de la consultation en télémédecine était de préciser : 1) la thérapeutique médicale chez 7 patients ; 2) l'indication d'une chirurgie ou d'un cathétérisme interventionnel chez 15 patients. Il n'y a eu aucune modification diagnostique significative mais chez 2 patients avec cardiopathie complexe des précisions anatomiques ont été apportées. Chez 3 patients, la discussion en vidéo-conférence a été essentielle pour faire accepter à la famille très réticente l'indication opératoire.

Conclusion. – La consultation de cardiologie pédiatrique et congénitale par télémédecine est une 1^{re} expérience en France. Ces vidéoconferences permettent aux patients du Sud de la Réunion de bénéficier d'avis sur la stratégie thérapeutique optimale et ce sans délai ni déplacement.

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Background

The present maturity of information technology allows telemedicine to be integrated into current medical practice. This facilitates access to specific competences and improves patient management, as well as saving human and material resources. The technique has long been applied in pediatric cardiology in Canada, with telesurveillance of patients 'hospitalised' at home, and more recently for cardiac pacing/defibrillation [1-5]. The relative rarity of congenital heart disease gives it an orphan disease status, requiring specialised centres in order to optimise patient's care using information from the latest data in the field. Now that teleconsultations have come of age, diagnostic consultations may in future be envisaged for certain peripheral centres with no regular cardiology service.

We report our experience of pediatric and congenital cardiology videoconference consultations between the cardiology department at St-Pierre Hospital in Réunion and the pediatric cardiology department at the teaching hospital in Toulouse. The aim of this work was to 1) verify the technical feasibility

of transmitting echocardiographic images, 2) determine an optimal therapeutic strategy for each patient, and 3) deliver precise information live to patients and their families.

Methods**Population (table 1)**

Five videoconferencing consultation sessions were organised between April 2006 and May 2007. 22 patients were involved (median age 3 years, age range 7 days to 48 years). Heart disease was congenital in 20 patients, and acquired in 2 patients. The aim of the telemedicine consultation was to specify: 1) medical treatment in 7 patients, and 2) an indication for surgery or interventional catheterisation in 15 patients. There was no significant change in diagnosis, but in 2 patients with complex heart disease some anatomical clarifications were made. For 3 patients, the videoconference discussion was essential to get the extremely reticent families to accept the indication for surgery.

Table 1 Therapeutic decisions according to clinical presentations.

N	Age	Heart Disease	Pathology	Therapeutic Decision
1	15 months	Hypokinetic dilated cardiomyopathy	Acquired	Medical
2	21 months	Right ventricular hypoplasia	Congenital	Surveillance
3	7 days	Left ventricular-right atrial fistula	Congenital	Interventional catheterisation
4	48 years	Partial atrioventricular canal, mitral leak	Congenital	Surgical
5	17 years	Interventricular communication with pulmonary artery hypertension	Congenital	Medical
6	9 years	Double discordance with interatrial communication and pulmonary stenosis	Congenital	Surveillance
7	11 years	Atrial flutter after surgery for congenital heart disease	Congenital	Medical
8	8 years	Hypertrophic cardiomyopathy with ventricular arrhythmia	Congenital	Medical
9	47 years	Coarctation of the aorta	Congenital	Surgical
10	15 days	Fallot's tetralogy	Congenital	Surgical
11	10 years	Ebstein's anomaly with junctional tachycardia	Congenital	Medical
12	5 months	Interventricular communication	Congenital	Surgical
13	3 years	Aortic supra-valvular stenosis	Congenital	Surveillance
14	8 months	Coronaro-cameral fistula of the right atrium	Congenital	Interventional catheterisation
15	1 month	Interventricular communication with pulmonary artery hypertension	Congenital	Surgical
16	3 years	Sinus venosus interatrial communication	Congenital	Surgical
17	9 years	Left heart obstruction	Congenital	Interventional catheterisation
18	20 months	Atrioventricular block	Congenital	Surveillance
19	3 years	Hypokinetic dilated cardiomyopathy	Acquired	Medical
20	20 months	Atrioventricular canal	Congenital	Surgical
21	5 years	Sinus venosus interatrial communication	Congenital	Surgical
22	1 month	Partial atrioventricular canal	Congenital	Surgical

Material

The videoconference equipment, POLYCOM VSX 7000 (R), was used to relay information between the two centres, using six high-debit digital telephone lines, allowing a transfer rate of 384 kbits/s and an image frequency of 25 frames per second. The transmitted sources alternated between the echographic video output and the signal from a video camera, with continuous audio transmission.

Echocardiography was performed using the ACUSON SEQUOIA (R) 6.091 system with a multifrequency 7V3c pediatric probe (3.5-7 MHz) and a 3V2c-S multifrequency adult probe (2 - 4 MHz) for the first two sessions, and the ALOKA PROSOUND SSD-5000 (R) with a UST-5294-5 multifrequency pediatric probe (5-7,5 MHz) and a UST-5297 multifrequency adult probe (2,14-3,75 MHz) for the others. Connection to the videoconference equipment was made through the S-VHS output on both machines. No video material was sent to the receiving centre in advance. The transmitted sources alternated between the echographic video output and the signal from a video camera, with continuous

audio transmission. The local operator could therefore be guided in real-time by the receivers regarding the choice of echocardiographic sections and the choice of Doppler modes. A technician locally was in charge of framing and zooming the video camera so that the patients could be examined by the specialists. The echocardiographic information was briefly reported on by the receiving centre team.

Videoconferences

The telemedicine consultations consisted of four stages :

- before the consultation with the patient and family, the cardiological and pediatric team at the Saint Pierre Hospital in Réunion presented the case history;
- the second stage included the clinical examination of the patient, and echocardiography was performed with real-time image transmission;
- the third stage consisted of an interview with the patient, their parents and the pediatric cardiologists at the Toulouse teaching hospital;

- once the patient and family had left, a discussion took place between the medical colleagues about the echocardiographic data as well as about therapeutic decisions.

Results

Feasibility of ultrasound transmission by telemedicine

It was possible to conduct the clinical consultation and echocardiography without sedation thanks to the reassuring presence of the parents during the videoconference. Nine out of the 22 patients were less than 2 years old. The quality of echocardiographic images received remotely (but checked locally thanks to the monitoring feature of the videoconferencing equipment) was considered satisfactory in all except 2 patients. For patient II (aged 21 months) the diagnosis of left ventricular communication with the right atrium could only be inferred due to poor resolution on the colour Doppler. Patient III at 7 days old was the youngest patient in the study; although the diagnosis of atrio-ventricular canal was made, a precise description of the atrio-ventricular valve could not be performed during this consultation.

Therapeutic decisions (table 1)

No diagnoses were corrected, but in two patients with complex heart disease some anatomical clarifications were made (patients IV and VI). In 7 patients, medical treatment was discussed: 4 had rhythm disorders (patients VII, VIII, XI) or a conduction defect (patient XVIII), 2 had hypokinetic dilated cardiomyopathy (patients I, XIX) and one had Eisenmenger's syndrome with interventricular communication (patient V). In 15 patients, a surgical procedure or interventional catheterisation was discussed between with the families. In 3 patients who required surgical management, the videoconference was essential to get the extremely reticent family to accept the therapeutic indication.

Videoconference costs

The cost of videoconferencing is made up of the material costs and the price of the telephonic communication. The hospitals in Toulouse and St Pierre already possessed the necessary material and no additional investment was necessary to perform the videoconferences. The cost of telephonic communication was assumed by St Pierre Hospital in Réunion, from its budget set aside for telemedicine. The average duration of the videoconference consultations was 1h30. The hourly rate for a line is 12.211 ₣ before tax. The hourly rate for a debit of 384 kb/s (six 64 kb/s digital lines) was therefore 12.211 ₣x6=73.266 ₣ before tax.

Discussion

This is the first time that telemedicine has been applied to pediatric and congenital cardiology consultations in France. The excellent transmission quality of echocardiographic images and the possibility of live discussions with the fami-

lies are the two major advantages of these videoconferences that took place between the hospitals in St Pierre in Réunion and Toulouse.

Telemedicine and technology

Telemedicine involves remote communication, using a suitable infrastructure, of a range of clinical elements and additional investigations, with the aim of establishing a diagnosis, deciding on treatment, or performing follow-up, without the need for the patient to travel far. In 1950, Gershon-Cohen et al reported their experience of telognosis (a neologism combining the words *teleo*, Roentgen and *diagnosis*) thus demonstrating the possibility of transmission of radiological images by telephone or radio [3]. The first interactive video link between two hospitals 112 miles apart was made in 1964 [2]. The telemedicine systems in use today originated from NASA's manned space flight programme, for which communication systems were developed to monitor astronauts' physiological parameters and commence in-flight treatment for certain emergency situations. The first reported uses in cardiology date from 1989 with the transmission of pediatric cardiology images by telephone [6]. Similar experiences were described in 1993 with the transmission of routine adult echocardiographic images and stress echography studies [7-9]. The first live digital transmissions were reported in 1996 [10]. In France in 2003, the experience of medical meetings and live transmission of coronary angiography images between hospitals in Rodez and Toulouse was reported [11].

Telemedicine and geography

The application of remote pediatric cardiology is linked to the geographical separation between the transmitting hospital and the receiving referral centre. Teams in Canada have reported their experience of videoconferencing between extremely isolated sites and a referral centre, which allowed diagnoses to be established, suitable treatment to be immediately instigated, and decisions to be taken on transferring patients [1, 12]. The cardiology department at the hospital in Saint Pierre in Réunion is the only cardiological service in the south of the island, serving approximately half of the island's population of 750.000 inhabitants. Communicating the cardiological case notes is a necessity and relies on various means of communication, such as telephone, posting video cassettes or emailing scanned ECG images. With all of these techniques it is impossible to transmit real-time echocardiography data or give information live to patients and their families. Thanks to the quality inherent in a digital link and the absence of any perceptible time-delay, telemedicine has opened the way for videoconference consultations and allows interactive discussion between the participants. This has benefits for both the remote hospital and the receiving university departments. Telemedicine is recognised by the governing health authorities in France as an integral part of providing healthcare. The St Pierre Hospital in Réunion even has a budget set aside for videoconferencing. Several studies have demonstrated that the savings in terms of avoiding transport outweigh the investment necessary for the equipment and the cost of telephone charges [2,4].

Conclusion

Congenital and pediatric cardiology videoconference consultations allow two distant centres to respond to health-care needs (taking therapeutic decisions and providing information for families), avoiding often long and expensive journeys. They also allow remote medical teams to exchange medical information in a convivial manner and respond to the needs of continuing education, which are essential in medicine, particularly in a field as specialised as pediatric and congenital cardiology.

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